

U.S. Patent Application Serial No. 10/539,758

Amendment dated December 7, 2009

Reply to Office Action dated July 7, 2009

Amendments to the Claims:

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

1. (Currently Amended) A cold rolled steel composition comprising:

- C : between 1300ppm and 2600ppm,
- Mn : between 1000ppm and 2200ppm,
- Al : between 100008000ppm and 15000ppm,
- Si : between 2000ppm and 6000ppm,
- P : between 400 and 1000ppm,
- S : maximum 120ppm,
- N : maximum 200ppm,
- Ti : maximum 1000ppm,
- Nb : maximum 1000ppm,
- V : maximum 1000ppm, and
- B : maximum 10ppm

the remainder being iron and incidental impurities; wherein the cold rolled steel composition comprises a microstructure comprising 30–75 vol% ferrite; 10–40 vol% bainite, 0–20 vol% retained austenite and 1–10 vol% martensite.

2. (Original) The steel composition according to claim 1, comprising a carbon content between 1300ppm and 1900ppm.

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3. (Original) The steel composition according to claim 2, comprising a carbon content between 1350ppm and 1900ppm.

4. (Original) The steel composition according to claim 2, comprising a carbon content between 1400ppm and 1900ppm.

5. (Original) The steel composition according to claim 1, comprising a carbon content between 1700ppm and 2300ppm.

6. (Original) The steel composition according to claim 1, comprising a carbon content between 2000ppm and 2600ppm.

7. (Previously Presented) The steel composition according to claim 2, comprising :

- Mn : between 13000ppm and 22000ppm,
- Al : between 8000ppm and 14000ppm,
- Si : between 2500ppm and 4500ppm,
- P : between 600 and 1000ppm,
- S : maximum 120ppm,
- N : maximum 150ppm,
- Ti : maximum 200ppm,
- Nb : maximum 100ppm,
- V : maximum 100ppm,
- B : maximum 5ppm.

8. (Original) The steel composition according to claim 7, comprising an aluminium content between 9000ppm and 13000ppm.

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9. (Withdrawn) A process for manufacturing a cold rolled TRIP steel product, comprising the steps of:

preparing a steel slab having a composition according to claim 1,

hot rolling said slab, wherein the finishing rolling temperature is higher than the Ar₃ temperature, to form a hot-rolled substrate,

cooling said substrate to a coiling temperature (CT) between 500°C and 680°C,

coiling said substrate at said coiling temperature,

pickling said substrate to remove the oxides,

cold rolling said substrate to obtain a reduction of thickness, with a minimum reduction of 40%.

10. (Withdrawn) The process according to claim 9, further comprising the steps of:

soaking said substrate at a temperature between 760°C and 850°C,

cooling said substrate with a cooling rate higher than 2°C/s to a temperature in the range 360°C to 450°C,

holding said substrate in said temperature range for a time less than 700s,

cooling said substrate to room temperature at a cooling rate higher than 1°C/s.

subjecting said substrate to a skinpass reduction of maximum 1.5%.

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11. (Withdrawn) The process according to claim 10, further comprising an electrolytic zinc coating step.

12. (Withdrawn) The process according to claim 9, further comprising the following processing steps:

soaking said substrate at a temperature between 760°C and 850°C,

cooling said substrate with a cooling rate higher than 2°C/s to the temperature of a Zn-bath,

holding said substrate in the temperature range between 490°C and 460°C for less than 200 seconds.

hot dip galvanising said substrate in said Zn-bath,

cooling said substrate to room temperature at a cooling rate higher than 2°C/s.

13. (Withdrawn) The process according to claim 12, further comprising the step of subjecting said substrate to a skinpass reduction of maximum 1.5%.

14. (Withdrawn) A steel product produced according to the process of claim 9 and having a microstructure comprising 30-75% ferrite, 10-40% bainite, 0-20% retained austenite and possibly 0-10% martensite.

15. (Withdrawn) A steel product produced according to the process of claim 10, said product comprising a carbon content between 1300ppm and 1900ppm, said product having a yield strength between 320MPa and 480MPa, a tensile strength above 590MPa, an elongation A80

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higher than 26% and a strain hardening coefficient, calculated between 10% and uniform elongation, higher than 0.2.

16. (Withdrawn) A steel product produced according to the process of claim 10, said product comprising a carbon content between 1700ppm and 2300ppm, said product having a yield strength between 350MPa and 510MPa, a tensile strength above 700MPa, an elongation A80 higher than 24% and a strain hardening coefficient, calculated between 10% and uniform elongation, higher than 0.19.

17. (Withdrawn) A steel product produced according to the process of claim 10, said product comprising a carbon content between 2000ppm and 2600ppm, said product having a yield strength between 400MPa and 600MPa, a tensile strength above 780MPa, an elongation A80 higher than 22% and a strain hardening coefficient, calculated between 10% and uniform elongation, higher than 0.18.

18. (Withdrawn) A steel product produced according to the process of claim 10, said product comprising a carbon content between 2000ppm and 2600ppm, said product having a yield strength between 450MPa and 700MPa, a tensile strength above 980MPa, an elongation A80 higher than 18% and a strain hardening coefficient, calculated between 10% and uniform elongation, higher than 0.14.

19. (Withdrawn) A steel product produced according to claim 14, having bake hardening BH2 higher than 40MPa in both longitudinal and transversal directions.

20. (Previously Presented) The composition of claim 1 wherein the steel composition is uncoated, electrogalvanised or hot dip galvanised TRIP cold rolled steel composition.

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21. (Withdrawn) An uncoated, electro-galvanised or hot dip galvanised TRIP steel product, produced in a process comprising a cold rolling step, the steel product being produced from a steel composition comprising:

- C : between 1300ppm and 2600ppm,
- Mn : between 10000ppm and 22000ppm,
- Al : between 8000ppm and 15000ppm,
- Si : between 2000ppm and 6000ppm,
- P : between 400 and 1000ppm,
- S : maximum 120ppm,
- N : maximum 200ppm,
- Ti : maximum 1000ppm,
- Nb : maximum 1000ppm,
- V : maximum 1000ppm, and
- B : maximum 10ppm;

the remainder being iron and incidental impurities; wherein the steel product has a microstructure comprising 30-75% ferrite, 10-40% bainite, 0-20% retained austenite and 0-10% martensite.

22. (Withdrawn) The steel product of claim 21, wherein the process comprises:

- (a) preparing a steel slab having a composition comprising:

- C : between 1300ppm and 2600ppm,
- Mn : between 10000ppm and 22000ppm,
- Al : between 8000ppm and 15000ppm,
- Si : between 2000ppm and 6000ppm,

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- P : between 400 and 1000ppm,
- S : maximum 120ppm,
- N : maximum 200ppm,
- Ti : maximum 1000ppm,
- Nb : maximum 1000ppm,
- V : maximum 1000ppm, and
- B : maximum 10ppm; the remainder being Fe and incidental impurities;

(b) hot rolling the steel slab, wherein the finishing rolling temperature is higher than the Ar₃ temperature, to form a hot-rolled substrate;

(c) cooling the substrate to a coiling temperature (CT) between 500°C and 680°C;

(d) coiling the substrate at the coiling temperature;

(e) pickling the substrate; and

(f) cold rolling the substrate to obtain a reduction of thickness, with a minimum reduction of about 40%.

23. (Withdrawn) The steel product of claim 22, wherein the process further comprises:

(g) soaking the substrate at a temperature between 760°C and 850°C;

(h) cooling the substrate with a cooling rate higher than 2°C/s to a temperature in the range of 360°C to 450°C;

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(i) holding the substrate at a temperature in the range of 360°C to 450°C for a time less than 700 s;

(j) cooling the substrate to room temperature at a cooling rate higher than 1°C/s; and

(k) subjecting the substrate to a skinpass reduction of no greater than 1.5%.

24. (Withdrawn) The steel product of claim 23 wherein the process further comprises an electrolytic zinc coating process.

25. (Withdrawn) The steel product of claim 23 wherein the process further comprises:

(g) soaking the substrate at a temperature between 760°C and 850°C;

(h) cooling the substrate with a cooling rate higher than about 2°C/s to the temperature of a Zn-bath;

(i) holding the substrate in the temperature between 460°C and 490°C for less than 200 s;

(j) hot dip galvanizing the substrate in the Zn-bath; and

(k) cooling the substrate to room temperature at a cooling rate higher than 2°C/s.

26. (Withdrawn) The steel product of claim 25 further comprising

(l) subjecting the substrate to a skinpass reduction of maximum 1.5%.

27. (Withdrawn) The steel product of claim 21 comprising a carbon content between 1300ppm and 1900ppm, the steel product having a yield strength between 320 MPa and 480

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MPa, a tensile strength greater than 590 MPa, an elongation A80 greater than 26% and a strain hardening coefficient, calculated between 10% and uniform elongation, higher than 0.2.

28. (Withdrawn) The steel product of claim 21 comprising a carbon content between 1700ppm and 2300ppm, the steel product having a yield strength between 350 MPa and 510 MPa, a tensile strength greater than 700 MPa, an elongation A80 greater than 24% and a strain hardening coefficient, calculated between 10% and uniform elongation, higher than 0.19.

29. (Withdrawn) The steel product of claim 21 comprising a carbon content between 2000ppm and 2600ppm, the steel product having a yield strength between 400 MPa and 600 MPa, a tensile strength greater than 780 MPa, an elongation A80 greater than 22% and a strain hardening coefficient, calculated between 10% and uniform elongation, higher than 0.18.

30. (Withdrawn) The steel product of claim 21 comprising a carbon content between 2000ppm and 2600ppm, the steel product having a yield strength between 450 MPa and 700 MPa, a tensile strength greater than 980 MPa, an elongation A80 greater than 18% and a strain hardening coefficient, calculated between 10% and uniform elongation, higher than 0.14.

31. (Withdrawn) The steel product of claim 21 having a bake hardening BH2 greater than 40 MPa in both longitudinal and transversal directions.